This document contains the AWIPS Interface Control Document(ICD) for the National Weather Service Telecommunications Gateway (NWSTG). This information is provided for the purposes of providing adequate information to ingest and decode the NOAAPORT data stream.

Additionally, as NWS field requirements change, so to will the data which will be transmitted via NOAAPORT in support of the NWS mission. Specifications regarding both data content and format may change in the future and the government is not responsible for the impact these changes may incur. If changes do occur, users will be notified prior to any significant change through the normal channels.

INTERFACE CONTROL DOCUMENT (ICD)

FOR THE

NATIONAL WEATHER SERVICE

TELECOMMUNICATIONS GATEWAY (NWSTG)

Prepared By
AWIPS System Acquisition Office, SAO321

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RECORD OF CHANGES

This page provides a record of all changes and revisions to this document. Changes are identified by the change identifier to the right of the document number on each change page (e.g., CH-1 for Change 1, CH-2 for Change 2, etc.). Revisions after the initial issue are identified by the revision identifier to the right of the document number on each page of the document (e.g., R1 for Revision 1, R2 for Revision 2, etc.). The initial issue of the document is considered Revision 0. Change packages only include those pages affected by the change. Revisions are a reprint of the complete document incorporating all previous changes.

Version	Document Number	Date
Revision 0 (Initial issue)	AAO130006	March 31, 1995
Revision 1	AAO130006R1	November 27, 1995
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Change 1	AAO130006R2 CH-1	November 2, 1998

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LIST OF EFFECTIVE PAGES

SECTION	PAGE NUMBERS	CHANGE/REVSION
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	1 thru 2	Rev 2
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1.0 SCOPE

The AWIPS, National Weather Service Telecommunications Gateway (NWSTG), Interface Control Document (ICD), specifies the interface requirements for layer 1, 2, 3 and 6 of the OSI model. In addition, it specifies the protocols and data formats necessary to exchange data between the NWSTG and the AWIPS, Network Control Facility (NCF).

2.0 REFERENCE DOCUMENTS

STANDARDS

Federal Standards:

FMC-S2-1990
Standard Format for Weather Data Exchange
Red Book
Among Automated Weather Information Systems

May 1990

FCM-S3-1991 Standard Telecommunications Procedures for Weather Data Exchange
October 1991

Source: Federal Coordinator For Meteorological Services and Supporting Branch
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
11426 Rockville Pike, Rockville, Maryland

GRIB Gridded Binary Format
WMO Code FM-92-VIII Ext
June 3, 1991

Source: American Meteorological Society
45 Beacon Street
Boston, Massachusetts 02108

Manual on Codes, Volume 1,
International Codes Part B, Binary Codes

BUFR Binary Universal Form for Representation

WMO FM 94 BUFR-IX
February 1998

Source: American Meteorological Society
45 Beacon Street
Boston, Massachusetts 02108

American National Standard Institute Standards

ANSI X3.4-1986 Coded Character Set - 7 Bit American National Standards Code For Information Exchange

Source: American National Standard Institute
1430 Broadway
New York, New York 10018

Electronic Industry Association (EIA)
Telecommunications Industry Association (TIA) Standard

EIA-530 High Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment

Source: Electronic Industry Association (EIA)
Engineering Department
2001 Eye Street N.W.
Washington, D.C. 20006

Consultative Committee on International Telegraphy and Telephony (CCITT) Standards:

X.25 Interface Between Data Terminal Equipment (DTE) And Data Circuit-Terminating Equipment (DCE) For Terminals Operating In The Packet Mode And Connected To Public Data Networks By Dedicated Circuits

Source:
U.S. Department of Commerce
National Institute of Standards and Technology
5285 Port Royal Road
Springfield, Virginia 22161

Other Government Documents
AWIPS, Systems/Segment Specification (SSS)

Source: AWIPS, System Acquisition Office, SAO321
1315 East West Highway
Silver Spring, Maryland 20910

3.0 PHYSICAL LAYER

This section specifies the interface characteristics for the physical Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE). The physical DTE is defined as the NWSTG data communications processing equipment.

3.1 DTE / DCE INTERFACE

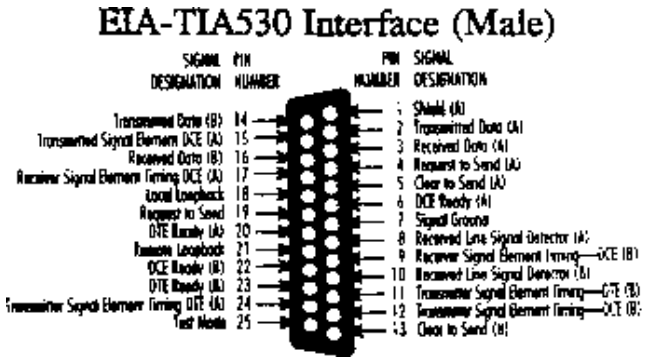
The physical DTE / DCE interface adheres to the EIA-530 Standard for Fractional T-1 to a Full T-1 rates.

3.1.1 SIGNAL CHARACTERISTICS

The general signal characteristics are as follows: The Transmit Data, Receive Data, Transmit Clock, Receive Clock and External Clock are all balanced interface circuits. All remaining interface circuits are single ended.

3.1.2 MECHANICAL CHARACTERISTICS

The mechanical interface equipment and connector specifications are defined as a 25 position female DB25 Type connector. The DB25 connector that the contractor will need to interface to the Governments ' data communicati ons equipment is depicted below.



EIA-530 INTERFACE				
25-PIN		EIA 530 CIRCUIT	DTE/DCE	530 DESCRIPTION
A	B			
1				Shield
7		AB		Signal Ground
2	14	BA	→	Transmitted Data
3	16	BB	←	Receive Data
4	19	CA	→	Request to Send
5	13	CB	←	Clear to Send
6	22	CC	←	DCE Ready
20	23	CD	→	DTE Ready
8	10	CF	←	Received Line Signal Detector
24	11	DA	→	Transmitter Signal Element Timing (DTE)
15	12	DB	←	Transmitter Signal Element Timing (DCE)
17	9	DD	←	Receiver Signal Element Timing (DCE)
18		LL		Local Loopback
21		RL		Remote Loopback
25		TM		Test Mode

3.2 COMMUNICATIONS LINK CHARACTERISTICS

The communications link characteristics of the NWSTG interface is shown below:

Type - Full Duplex

Data Rate - 56,000 bp/s

Interface - EIA-530

Timing - The NWSTG Acting As The DCE Will Provide Transmit and Receive Signal Element Timing To The AWIPS DTE.

4.0 LOGICAL REQUIREMENTS

The logical requirements of the communications link refer to levels of protocol above the physical layer (Open Systems Interconnection (OSI) Reference Model Layer I). NWSTG communications support three logical layers of protocol; Data Link (Frame), Network (Packet), and Presentation Layer. There is no requirement for the Transport Layer, Session Layer, and Application Layer. The logical layers of protocol are implemented with software resident in the NWSTG data communications processing system.

In this section, stations may be referred to as the host (NWSTG) or remote (NCF) station. For this document, X.25/LAPB frames are abbreviated as [command/response ADDRESS] COMMAND/RESPONSE (Poll/Final/0/1). If an address value is given, it is assumed the NWSTG is address X'03' and the NCF address is X'01'.

4.1 DATA LINK LAYER

The Data Link Layer (OSI layer II) defines the link control (access) procedures and means for information exchange between two machines over a communications circuit. The functions of the logical DTEs and DCEs is described in terms of roles as logical combined stations operating in logical states and modes.

All synchronous NWSTG Data Link Level communications conform to CCITT Recommendation X.25/LAPB (1988) for synchronous links. This protocol provides procedures for:

- Logical establishment and disconnection of communications links
- Data Insensitive (transparent) link data transmission

- Error detection and recovery from data transmission errors
- Enhancement of link capabilities

The following Data Link Level sections provide the frame structure, station descriptions, logical states and modes, and logical configurations for synchronous NWSTG to NFC inter-processor communications. Applicable sections of Recommendation X.25 appear in this document as X.25 {n.n}, where n.n is the X.25 section number.

4.1.1 CLASS OF PROCEDURE

The NWSTG interface utilize the Link Access Procedures, Balanced (X.25/LAPB) under Single Link Procedures (SLP) defined in X.25 {2.1.1}

4.1.1.1 BALANCED CONFIGURATION

The NWSTG and NCF function in a balanced configuration, connected point-to-point (X.25 {2.1.4}). In a balanced configuration, either station may transmit and receive, command and response frames. Stations have compatible data transfer and link control capability.

4.1.1.2 MODES OF OPERATION

4.1.1.2.1 ASYNCHRONOUS BALANCED MODE

While in Information Transfer State (ITS), the NWSTG and NCF stations operate in Asynchronous Balanced Mode (ABM). ABM grants stations the freedom to asynchronously (without remote station permission) initiate transmission of all balanced configuration command frames. This allows both stations to transfer information or indicate status without a poll cycle delay.

4.1.1.2.2 ASYNCHRONOUS DISCONNECT MODE

NWSTG and NCF stations use Asynchronous Disconnect Mode (ADM) while in the Logically Disconnected State (LDS). ADM is a non-operational mode in which a station is logically disconnected from the link. In ADM, a station may not transmit or receive information.

4.1.2 FRAME STRUCTURE AND TRANSMISSION

The NWSTG Data Link frame structure is as defined in X.25 {2.2}. The following sections describe the frame structure and specify transmission characteristics. However, only the modulo 8 mode of operation is supported.

4.1.2.1 FRAME FIELD DEFINITION

All commands, responses and information transferred between stations are binary codes conveyed within a frame. The link frame size may range from 2 to 256 bytes, however, the longest information field within a frame is 259 bytes (which includes network layer overhead of 3 bytes). Thus, the actual frame size (not including flags) is: {259 byte buffer + [A field (1) + C field (1) + FCS (2)]} = 263 bytes. Product data greater than 256 bytes is segmented into several information frames.

All NWSTG communication frames (as specified in X.25 {2.2} must conform to the following structure: F, A, C, [I,] FCS, F

where:

F = Flag sequence
A = Address field
C = Control Field
I = Information field
FCS = Frame check sequence.

All transmissions are in frames containing three required fields; the address field (A-field), control field (C-field), and frame check sequence (FCS). The information field (I-field) is optional and may be used for information frames (I-frame) and frame reject response frames (FRMR). I-frame I-fields are variable length and may be transmitted between the C-field and FCS. A leading and trailing flag sequence marks the start and end of each frame.

4.1.2.1.1 FLAG FIELD

A flag sequence (FLAG) is a unique succession of bits used to delimit frames. The FLAG is a zero bit followed by 6 one bits, followed by a zero bit (binary 01111110). Each station on the link continuously searches for FLAGs. If a FLAG is preceded by a non-FLAG, it is closing a frame and the previous 16 bits

were the FCS of the closed frame. If a FLAG is followed by a non-FLAG, it is an opening FLAG and the next sequence received is the A-field. A single FLAG may be used as both closing FLAG for one frame and the opening FLAG for another frame.

4.1.2.1.2 ADDRESS FIELD

The address field contains the link address of a local (response frame) or remote (command frame) station. Subsection 4.1.2.3 provides details on station addressing.

4.1.2.1.3 CONTROL FIELD

The control field contains a command or response control code. Sequence numbers are included within the C-field of numbered commands and responses. The C-field length is 1 byte for normal control. The send and receive sequence variables, N(s) and N(r), contain 3 bits for normal control. Subsection 4.1.3 provides details on commands and responses. The control fields used in NWSTG communications are shown below:

LAPB CONTROL FIELD FORMATS

Control field bits	1	2	3	4	5	6	7	8
I format	0	N(S)			P	N(R)		
S format	1	0	S	S	P/F	N(R)		
U format	1	1	M	M	P/F	M	M	M

N(S) Transmitter send sequence number (bit 2 = low-order bit)
N(R) Transmitter receive sequence number (bit 6 = low-order bit)
S Supervisory function bit
M Modifier Function bit
P/F Poll bit when issued as a command, final bit when issued as a response. (1 = Poll/Final)

4.1.2.1.4 FRAME CHECK SEQUENCE (FCS)

For error detection purposes, all frames include a 16-bit FCS just prior to the closing FLAG. The contents of the A, C and I-fields are used to calculate the FCS. Subsection 4.1.2.4 describes the use of FCS in error detection.

4.1.2.2 SEPARATION

Frame transmissions are separated by at least one FLAG. A closing FLAG may be used to open the next frame. Interframe time is handled by transmitting continuous FLAGs or "idle line" (all ones). There is no upper limit to the number of FLAG that may be transmitted between frames.

4.1.2.3 ADDRESSING

The address field contains the link address of a station. Two stations in a balanced configuration must have different station addresses. The NWSTG normally use a single octet link address of X'03'. Remote Station (NCF) assign link address is X'01' and it sends commands to address X'03' (NWSTG).

In ABM, the link address is used to distinguish between command and response frames. Command frames carry the address of the remote (destination) station. Response frames include the address of the local (transmitting) station. All stations must be capable of accepting commands utilizing a global address.

4.1.2.4 ERROR DETECTION

The transmission integrity of each received frame is judged by examination of the frame check sequence (FCS). The FCS is the remainder of a cyclic redundancy checking, modulo-2 division, using the CCITT V.41 generator polynomial (x**16 + x**12 + x**5 + 1) as a divisor. The FCS within each frame is the 16-bit version specified in X.25 {2.2.7}.

A transmitting station generates an FCS based on the A, C and I-field bit stream (excluding zeros inserted for transparency). The FCS is then transparently transmitted prior to the trailing FLAG. The receiving station computes FCS of the incoming frame. When a trailing FLAG is received, the receiving station has already included the incoming FCS in its calculation. The addition of this sequence causes the calculation of the incoming stream to have a remainder of zero if the frame is received without transmission error. The presence of a non-zero reminder indicates a physical corruption of the frame resulting in an FCS error.

4.1.2.5 TRANSPARENCY

FLAGs are not permitted to appear within a frame's A-field, C-field, I- field, or FCS. Zero bit insertion / deletion (ZBID) is used to code these fields such that, regardless of field data, a FLAG will never occur within a frame. The ZBID technique ensures frame transparency.

When transmitting a frame, a station mast perform zero-bit insertion. The station must check all bits being transmitted and, upon detection of a '011111' sequence, insert a 0-bit. Thus a data byte X'7E' is transmitted as the binary series '011111010'.

A station receiving a frame must perform zero-bit deletion. The station monitors all bits being received. When a 1011111' sequence is encountered, the station inspects the next (seventh) bit. If the seventh bit is a 0, the 0-bit is deleted and the 1011111' sequence is accepted as data. If the seventh bit is a 1, then the next (eight) bit is immediately inspected. If the eight bit is a 0, the '01111110' sequence is accepted as a FLAG. If the eight bit is a 1, it is an abort (7 < = contiguous l's < 15) or idle (contiguous l's > = 15) sequence. The ZBID procedure is also described in X.25 {2.2.6}.

4.1.3 COMMANDS AND RESPONSES

X.25, Section 2.0, functionally defines a set of commands and responses for controlling link operation. The particular subset used for synchronous NWSTG communications consists of the basic repertoire for BA class procedures X.25 {2.3.4}. The resulting set of commands and responses is summarized below.

LAPB COMMANDS and RESPONSES

			1	2	3	4	5	6	7	8
Format	Command	Response	Encoding							
Information Transfer	I (information)		0	N(S)			P	N(R)		
Supervisory	RR (receive ready)	RR (receive ready)	1	0	0	0	P/F	N(R)		
	RNR (receive not ready)	RNR (receive not ready)	1	0	1	0	P/F	N(R)		
	REJ (reject)	REJ (reject)	1	0	0	1	P/F	N(R)		

Unnumbered	SABM (set asynchronous balanced mode)		1	1	1	1	P	1	0	0
	DISC (disconnect)		1	1	0	0	P	0	1	0
		DM (disconnected mode)	1	1	1	1	F	0	0	0
		UA (unnumbered acknowledg-ment)	1	1	0	0	F	1	1	0
		FRMR (frame reject)	1	1	1	0	F	0	0	1

4.1.3.1 INFORMATION (I) Command / Response

The function of the I-frame is to transfer sequentially numbered frames containing an I-field to the other station.

I-fields to be transmitted are received from the Network (packet) Level interface. Correctly received I-fields are passed to the Network Level interface. The contents of the I-field are ignored by the Data Link Level.

I-frames are only transmitted while in Information Transfer State (ITS). ITS is described in subsection 4.1.4.2.

4.1.3.2 RECEIVER READY (RR) Command / Response

The RR supervisory frame is sent by a NWSTG station to:

(1) Indicate it is ready to receive an I-frame
(2) Acknowledge previously received I-frames numbered up to and including N(r)-1
(3) Respond to an I-frame or RR which had the poll bit set
(4) Clear a busy condition that vas initiated by transmission of an RNR
(5) Request status by setting the poll bit

4.1.3.3 RECEIVER NOT READY (RNR) Command / Response

The RNR supervisory frame is used to indicate a busy condition (see subsection 4.1.6.1). I-frames numbered up to and including N(r)-1 are acknowledged. I–frames numbered N(r) and

any subsequent I-frames are not acknowledged. The acceptance status of subsequent I-frames is indicated by subsequent S-frames or I-frames.

The RNR frame may be used, with poll bit set, to query a remote station of its status.

4.1.3.4 REJECT (REJ) Command / Response

The REJ supervisory frame is used to request retransmission of I-frames, starting with the frame numbered N(r). Unacknowledged I-frames numbered N(r)-l and below are acknowledged.

The REJ frame may be used, with poll bit set, to query a remote station of its status (recommended are I, RR or RNR). Only one REJ exception condition for a given direction of information may be established at any time.

4.1.3.5 SET ASYNCHRONOUS BALANCED MODE (SABM) Command

The SABM unnumbered command is used to place the addressed station in Asynchronous Balanced Mode (ABM), where all control fields are one byte in length for normal control. The (SABM) receiving station confirms acceptance of [C]SABM(P) by immediately transmitting [R]UA(F) and entering ITS. The (SABM) sending station enters ITS upon receipt of [R]UA(F). A [C]SABM(P) will be re-transmitted if the sending station's status timer expires (refer to subsection 4.1.5). In LDS, the consecutive poll time-out count is not incremented, so there is no limit to the number of link set-up attempts.

The SABM may be used in LDS for link set-up, or in ITS for link reset. In either case, the SABM/UA exchange will cause both stations to initialize (0) their send and receive sequence numbers. It is recommended that the poll bit in a SABM control field always be set.

4.1.3.6 DISCONNECT (DISC) Command

The DISC unnumbered command is used by a station to inform the remote station of operation suspension. Acceptance of the DISC is confirmed by immediately transmitting UA or DM, which upon receipt causes the station that sent the DISC command to

enter LDS. Previously unacknowledged I-frames remained unacknowledged.

4.1.3.7 UNNUMBERED ACKNOWLEDGEMENT (UA) Response

The UA unnumbered response is used to acknowledge the receipt and acceptance of unnumbered commands. Action on unnumbered commands is not taken until transmission of UA. If the acknowledged unnumbered command had poll bit set, the UA response should have the final bit set.

4.1.3.8 DISCONNECTED MODE (DM) Response

The DM response is used to report status where a station is in the LDS. While in LDS any command, other than SABM, should be acknowledged by transmission of DM with the final bit set to 1.

4.1.3.9 FRAME REJECT (FRMR) Response

The FRMR response is used to report an error condition not recoverable by retransmission of the identical frame (see subsection 4.1.6.4).

The basic information field, which immediately follows the control field and consists of 3 bytes, is returned with this response to provide the reason for rejection (X.25 {2.3.4.9}). Refer to the LAPB FRMR Information Field Format below:

LAPB FRMR INFORMATION FIELD FORMAT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Rejected frame control field								0	V(S)			C/R	V(R)			W	X	Y	Z	0	0	0	0

— Rejected frame control field is the control field of the received frame which caused the frame reject.
— V(S) is the current send state variable value at the DCE or DTE reporting the rejection condition (bit 10 = low-order bit).
— C/R set to 1 indicated the rejected frame was a response. C/R set to 0 indicated the rejected frame was a command.
— V(R) is the current receive state variable value at the DC, CE or DTE reporting the rejection condition (bit 14 = low-order bit).
— W set to 1 indicates that the control field received and returned in bits 1 through 8 was undefined or not implemented.
— X set to 1 indicates that the control field received and returned in bits 1 through 8 was considered invalid because the frame contained an information field which is not permitted with this frame or is a supervisory or unnumbered frame with incorrect length. Bit W must be set to 1 in conjunction with this bit.
— Y set to 1 indicates that the information field received exceeded the maximum established capacity.
— Z set to 1 indicates the control field received and returned inn bits 1 through 8 contained an invalid N(R).

Note — Bits 9 through 21 to 24 will be set to 0.

4.1.4 LINK OPERATION STATES

Any physically connected and logically active station (i.e., NWSTG or NCF) will conduct communications in two logical states; Logically Disconnected State (X.25 {2.4.4.4}), or Information Transfer State (X.25 {2.4.4.2}). The following subsections of this document define the logical states and describe state transitions.

4.1.4.1 LOGICALLY DISCONNECTED STATE (LDS)

The LDS prevents a station from appearing on the link, in a fully operational sense, during unusual situations or exception conditions that might cause sequence number mismatches or ambiguity of operational mode. While in LDS, a station is logically disconnected from the link and may not transmit or receive, information or supervisory frames. The response capability of a combined station in LDS is limited to accepting a mode setting command (SABM or DISC) and transmitting a DM or UA response at any respond opportunity.

A station will indicate its willingness to set up the data link by transmitting continuous flags. Either station may initiate link setup procedures.

Upon achieving physical connection to a NWSTG host, the remote station (NCF) will find a NWSTG host in the LDS. In LDS, a NWSTG station will respond to [03]SABM(P) with [03]UA(F) and reset its send and receive variable, and when addressed and polled with any other valid command ([03]CMD(P)), respond [03]DM(F). The remote station (NCF) (logical DTE) transmits the proper mode-setting command [03]SABM(P) to set up the link and enter Information Transfer State (ITS). X.25 {2.4.4.1} provides more detailed link set up procedures. Any of the following events may cause the station to enter the LDS:

- station is turned off
- station recovers from a power interruption
- station becomes logically active by software request
- station becomes logically active by operator request
- station receives DISC command (ITS -> LDS)
- station status timer (T1 and variable N2) expires (ITS -> LDS)

4.1.4.2 INFORMATION TRANSFER STATE (ITS)

While in ITS, a station may transmit and receive information and control frames. The NWSTG and NCF stations conduct information transfer as defined in X.25 {2.4.4.2}. Either host will achieve a state transition from LDS to ITS upon the successful transmission of [R]UA(F) in response to [C]SABM(P). The remote station should enter ITS upon reception of [R]UA(F) in response to a [C]SABM(P) transmission.

While entering ITS, a station must initialize (0) its send sequence number, N(s), receive sequence number, N(r), consecutive poll time-out count and consecutive I-frame re-transmission count. The first I-frame transmitted has N(s)=0. Send sequence numbers for subsequent I-frames are incremented by 1, modulo 8 (e.g., N(0), N(l), N(2),...,N(7), N(0) ....). A receiving station acknowledges I-frames by transmitting a numbered frame with control field N(r) equal to the next expected I-frame N(s) (e.g., [C]I(X){0,X} is acknowledged by [R]RR(X){1} or [R]I(X){X,1}.

When in ITS, stations may use the following commands and responses for the purposes described:

[C]I(X)N(s)N(r)	— Transfer of sequentially numbered frames containing information fields as specified in subsection 4.2
[C/R]RR(X)N(r)	— Acknowledgement of successful reception of I-frame(s) or status polling
(C/R]RNR(X)N(r) [C/R]REJ(X)N(r)	— Report of and recovery from exception conditions as defined in subsection 4.1.6
[R]FRMR(X)N(s)N(r)	<I-field bits>
where: <I-field bits>	are bit settings contained within the I-field of the FRMR frame. The location and meaning of the information field bits are defined in subsection 4.1.3.9.

4.1.5 TIMING CONVENTIONS

Data link level procedures (LAPB) of X.25 call for 3 general purpose timers, namely T1 (X.25 {2.4.8.1}), T2 (X.25 {2.4.8.2} and T3 (X.25 {2.4.8.3}). These timers in conjunction with a retry-count variable N2 (X.25 {2.4.8.4}) are used extensively in data link setup (X.25 {2.4.4.1}), information transfer (X.25 {2.4.4.2}), during data link disconnect (X.25 {2.4.4.3}) and while in the disconnect state (X.25 {2.4.4.4}). An outline of each timer along with the default values used in the NWSTG are given in subsections 4.1.5.1 to 4.1.5.3.

4.1.5.1 FRAME UNACKNOWLEDGED TIMER (T1) - 10 Seconds

The NWSTG Frame Unacknowledged Timer indicates the amount of time which may elapse before retransmission of a frame is initiated. If the timer expires the frame is retransmitted and the Retry-count variable (N2) is incremented to N2 = 4. If the Retry-count reaches the maximum the NWSTG host will execute the data link reset procedure in X.25 {2.4.7.2}.

The value of the DTE Timer T1 system parameter may be different than the value of the DCE Timer T1 system parameter. These values should be made known to both the DTE and the DCE, and agree on the period of time for both the DTE and DCE.

4.1.5.2 FRAME ACKNOWLEDGE TIMER (T2) - 0 Seconds

The Frame Acknowledge Timer indicates the maximum amount of time which may elapse before an acknowledgement frame must be initiated in order to ensure its receipt before the remote DTE or DCE's T1 expires. Currently this timer is implemented for immediate response with no piggyback acknowledgement on the I-frames.

The value of the DTE Timer T2 system parameter may be different than the value of the DCE Timer T2 system parameter. These values should be made known to both the DTE and the DCE, and agree on the period of time for both the DTE and DCE.

4.1.5.3 LONG IDLE TIMER (T3)

The Long Idle Timer indicates the amount of time before an observed excessively long idle channel state condition is passed to the packet level. However, the NWSTG does not perform the T3 Timer function and is currently not implemented.

4.1.6 EXCEPTION CONDITION REPORTING AND RECOVERY

Both the NWSTG and NCF stations should be capable of recovery from exception conditions resulting from transmission, station malfunctions, and operational situations. The definition of these conditions and their recovery procedures is described in subsections 4.1.6.1 to 4.1.6.5.

4.1.6.1 BUSY CONDITION

A busy condition occurs when a station cannot receive, or continue to receive, information frames. A station busy condition is reported by transmission of [C/R]RNR(X){r} (X.25 {2.3.5.1}). A remote busy condition is cleared upon reception of [C/R]RR(X){r}, [R]REJ(X){r}, [C]SABM(X), or [R]UA(X) (UA is only in response to SABM).

When a NCF busy condition is detected, the NWSTG host will complete transmission of the current frame, respond if necessary, and cease further transmission of I-frames. The NCF station should respond [C]RNR(F){r} if busy and able to transmit. If ready, the NCF station should respond to poll with [R]RR(F){r}. The NCF station, whose busy condition has been cleared and has not yet been polled, may transmit [C]RR(X){r} to indicate its

ready status. The NWSTG would follow an identical procedure if it experienced a busy condition.

4.1.6.2 SEQUENCE ERROR

A sequence error occurs when a station receives an uncorrupted I-frame with an N(s) value not equal to receiving station's N(r) variable. A sequence exception may result from a transmission error (bad FCS) on a previous I-frame.

A station detecting a sequence error mast not increment its N(r) variable and must discard the I-field portion of the LAPB frame, or any subsequent I-frames until the correct N(s) is received. The station should accept and process the N(r) and P/F portion of the frame (X.25 {2.3.5.2}).

Retransmission of lost or errored I-frames is initiated by the expiration of the frame unacknowledged timer (subsection 4.1.5.1) or use of rejection recovery. Upon receipt of an I-frame with N(s) <> local N(r), a NWSTG host will immediately transmit [C/R]REJ(X){r} and note the existence of a sequence exception.

Outstanding I-frames numbered N(r)-1 and below are acknowledged. The presence of N(r) in REJ permits the station that has detected the sequence error to inform the transmitting station of its next expected I-frame N(s). The station receiving a REJ frame should sequentially retransmit I-frames starting with the I-frame N(s) equal to N(r) in the received REJ.

4.1.6.3 FRAME CHECK SEQUENCE (FCS) ERROR

Any frame received with an FCS error will be discarded by the receiving station. The receiving station should not act on any frame with an FCS error because no portion of such a frame may be considered reliable. Rejection of the frame is implied by the receiving station's failure to take action, thus causing the transmitting station's unacknowledged timer (T1) to expire. Failure to act will indirectly cause explicit rejection of subsequent I-frames if the FCS-errored frame was an I-frame (due to sequence error).

4.1.6.4 FRAME REJECTION

A frame reject exception condition is established upon receipt-of an error-free frame (good FCS) which creates an error condition that is not recoverable by retransmission of the identical frame. The NWSTG host will detect a frame reject error condition upon receipt of a frame with:

- a control field that is invalid or unimplemented
- an I-field which exceeded the maximum established length
- an invalid N(r) - (i.e., an N(r) pointing to a previously transmitted and acknowledged I-frame, or to an I-frame which has not been acknowledged and is not the next sequential I-frame pending transmission)
- receipt of a frame with an information field which is not permitted or receipt of a supervisory or unnumbered frame with an invalid length.

The exception condition will be reported to the remote station by transmission of a frame reject (FRMR) response as specified in X.25 {2.3.4.9}.

The reason for frame rejection is included in the FRMR basic information field as specified in subsection 4.1.3.9.

4.1.6.5 MODE SETTING CONTENTION

A mode-setting contention situation (also known as a collision) exists when a station issues a mode setting command ([C]SABM(X), or [C]DISC(X)) and before receiving an appropriate response ([R]UA(X) or [R]DM(X)), receives a mode setting command from the remote station.

4.2 NETWORK LAYER

The Network (Packet) Layer (OSI III) defines the packet format-and control procedures for the exchange of packets containing control information and user data between the logical DTE (remote) and logical DCE (host).

The NWSTG Network Layer performs the basic functions of the DTE/DCE Packet Level interface described in CCITT Recommendation X.25 (1988), Section 3.0, for Permanent Virtual Circuits. The NWSTG Network Layer is certified X.25 Packet Level software.

The NWSTG Packet Layer enables a transmitting station to break large blocks of information into reasonably-sized Data Link I-frames which, when received, are reassembled by the receiving station. NWSTG implementation of five Logical Channels permits the establishment of multiple (simultaneous) Permanent Virtual Circuits on a single Physical (and Data Link) interface. This allows unassociated application tasks to transmit and receive data on the same Physical Link.

Logical Channels grant establishment of five NWSTG, Permanent Virtual Circuits for physical 56Kbp/s circuit 1 (reference subsection 4.2.3). Logical Channel Group (LCG) 0, Circuit (Logical Channel Number) 0, is used for Restart and Diagnostic procedures. LCG 0, Circuit 1 is used for GRIB and BUFR data, LCG 0, Circuit 2 is used for ASCII data that contain raw observations, LCG 0, Circuit 3 is used for graphic data described in the FCM-2-1990 Red Book format and LCG 0, Circuit 4 is used for high priority ASCII data. The PVC assignment may be different for each of the remaining seven 56Kbp/s circuits that will be required between the NWSTG and the AWIPS NCF. Each PVC assignment will be made prior to the installation of each FTS2000 56Kbp/s circuit.

4.2.1 PACKET FORMATS

The data packet header is the first three bytes of a Data Link I-field within an I-frame which define the PVC used for data transmission.

4.2.1.1 GENERAL PACKET FORMAT

The Network Layer packet header structure is illustrated below:

Network Layer Packet Header Structure

byte

1 GFS LCG#
2 CIRCUIT #
3 PACKET TYPE

where: GFS General Format Specifier and

LCG# Logical Channel Group Number

General Format Specifier:

The GFS is a 4-bit field which depicts the format of the header. The value of this field is binary 0001 for modulo 8 format.

Logical Channel Group Number (Group Identifier):

The LCG# is a 4-bit field which specifies the channel group of the transmission. LCG# and Circuit Number combine to define a unique Virtual Circuit. This field is always binary 0000.

Circuit Number:

The Permanent Virtual Circuit Number (PVC#) (also referred to as the Logical Channel Number) field is 1 byte which defines a unique Logical Channel Number for each LCG. For restart and diagnostic packets this is binary '0000', for data transfer it is '0001', '0010', '0011' or '0100'.

Packet Type:

This 1 byte field describes the packet type. 4.2.2.10 lists all implemented packet types.

4.2.1.2 PACKET SEQUENCING

Each data and flow control packet has an associated sequence number. In normal flow control, sequence numbers cycle through the entire range 0 to 7. The current NWSTG implementation supports normal flow control (i.e., modulo 8).

Upon initialization, Circuit send and receive sequence variables, P(s) and P(r) respectively, are reset (0). The first data packet transmitted has P(s)-0. Sequence numbers for subsequent data packets are incremented by 1, modulo 8 (i.e., P(0), P(l), P(2), ..., P(7) ,P(0) ,...)

The receiving station acknowledges packets by their sequence number. Use of sequence numbers permit transmission of subsequent data packets without waiting for acknowledgement of previous packets based on the size of the transmit/receive window. The default for this window for NWSTG is 7. Data packets with P(s) are acknowledged with a data packet or flow control packet P(r), where P(r)=P(s+l) (i.e., the next expected P(s)).

4.2.2 PACKET TYPES

The NWSTG Network Layer supports a subset of the Virtual Circuit packets defined in X.25 {Table 14/X.25} for PVCs. This section defines the packet types implemented in the NWSTG Network Layer.

4.2.2.1 DATA PACKETS

Data packets are used to transmit higher-level (user) data through a PVC. Large blocks of users data are partitioned into a series of data packets which are transmitted as individual Data Link I-frames. The Data Link I-field of a data packet contains a 3-byte packet header and a user-relevant data field. Total Network level user-relevant data field will not exceed 256 bytes. Bits Q and D of the General Format Specifier field (byte 1) are the Qualifier bit and the Delivery Confirmation bit, respectively. The Q and D bits are not used by the NWSTG and are set to zero. The 3 high-order bits of the Packet Type field, P(r), contain the sequence number of the next expected data packet. The 3 high-order bits of the low-order nibble, P(s), contain the sending sequence number of the packet. Data packet, P(s), is acknowledged with a data packet or flow control packet (RR, RNR) containing a P(r) greater than P(s). The low-order bit

of the P(r) field is the More (M) bit. The More bit is set to indicate subsequent data packets are pending for this transmission of an NWSTG product. The More bit is reset for the final data packet of a given NWSTG product. Transmission of an NWSTG product is complete upon receipt of acknowledgement for the final data packet. The format for the Data Packet is depicted below.

DTE and DCE DATA PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General Format Identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	P(R)			M	P(S)			0
	USER DATA							

4.2.2.2 INTERRUPT PACKET

A DTE may send an Interrupt Packet that bypasses the flow control procedure used for Data Packets. The Interrupt Packet does not contain a send or receive sequence number and is not blocked by any RNR or a closed window. The Interrupt Packet can carry up to 32 bytes of user data and is to be delivered to the destination DTE by the network layer at a higher priority than the Data Packet. This packet is defined in X.25 {4.3.7}. The format for the Interrupt Packet is depicted below.

DTE and INTERRUPT PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	Packet type identifier							
	0	0	1	0	0	0	1	1
4	Interrupt user data							

4.2.2.3 INTERRUPT PACKET CONFIRMATION

Confirmation of the Interrupt Packet is end-to-end; that is, the sending DTE receives a confirmation of an interrupt packet only after it has been delivered to the remote DTE. A DTE may not send another Interrupt Packet or data on any PVC until the outstanding Interrupt Packet is confirmed. The format for the Interrupt Confirmation Packet is depicted below.

DTE and DCE INTERRUPT CONFIRMATION PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	Packet type identifier							
	0	0	1	0	0	1	1	1

4.2.2.4 RECEIVER READY PACKET

The Receiver Ready (RR) packet is used to indicate a station is ready to receive the (7) data packets within the window, starting

with P(r), where P(r) is the value in the RR packet. The RR packet is also used to clear a Receive Not Ready condition as defined in subsection 4.2.2.5.

The 3 high-order bits of the RR Packet Type field represent the receiver packet sequence number of the transmitting station. The format for the RR Packet is depicted below.

DTE and DCE RR PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	P(R)				Packet type identifier			
					0	0	0	0	1

4.2.2.5 RECEIVER NOT READY PACKET

The Receiver Not Ready (RNR) packet is sent to indicate a temporary inability to accept additional data packets for a given PVC. A station receiving an RNR packet must stop transmitting data packets on the specified Logical Channel until the busy condition is cleared. The busy condition is cleared upon receipt of an RR packet or REJ packet. The window is updated (closing) by P(r) of the RNR packet.

The 3 high-order bits of the RNR packet type field contain the sending station's P(r). This P(r) value explicitly acknowledges data packets up to and including P(s)=P(r-1). The format for the RNR Packet is presented below.

DTE and DCE RNR PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	P(R)				Packet type identifier			
					0	0	1	0	1

4.2.2.6 RESET REQUEST PACKET

The Reset Request Packet is sent by the DTE to request reset of a permanent virtual circuit. The procedure for reset is described in X.25 {4.4.3}. A reset request is considered to have failed if a response is not received within the Reset Request Timer (T22) which causes the Retry Counter (N22) to be incremented. The default value for the Reset Request Timer is 180 seconds. The default: value for N22 is 4. The format for the Reset Request Packet is as follows:

RESET REQUEST AND RESET INDICATION PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	Packet type identifier							
	0	0	0	1	1	0	1	1
4	Resetting cause							
5	Diagnostic code							

Diagnostic code is optional for Reset Request Packets. The reset cause is defined in X.25 {Table 21/X.25} for PVCs. X.25 {4.4.3.3} defines the procedures to be followed in the event of a restart collision.

4.2.2.7 RESET CONFIRMATION PACKET

Once the logical channel is in the reset indication state a Reset Confirmation Packet is sent to indicate a "Ready" state. The time spent in the "Reset Requests" state must not exceed the default value given in subsection 4.2.2.6. The packet format for the Reset Confirmation Packet is as follows:

DTE and DCE RESET CONFIRMATION PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	Packet type identifier							
	0	0	0	1	1	1	1	1

4.2.2.8 RESTART REQUEST PACKET

The restart procedure defined in X.25 {3.3} is used to initialize all Permanent Virtual Circuits on the Network Layer. Permanent Virtual Circuits do not require call setup and clearing packets as noted in X.25 {Table 14/X.25}, which is accomplished at the Data Link Layer. Once a Restart Request Packet is transmitted by the DTE, a response (confirmation) must be received within the value of the Restart Request Timer (T20). If the Restart Request Timer expires and the Retry Count (N20) is exceeded, appropriate action should be taken at a higher level. The default value for the Restart Request Timer is 180 seconds and the Retry Count is 1. X.25 {3.3.3} defines procedures to be followed in the event of a restart collision. The Restart Request Packet format is as follows:

	RESTART REQUEST AND RESTART INDICATION PACKET FORMAT							
	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier							
	1	1	1	1	1	0	1	1
4	Restarting cause							
5	Diagnostic code							

Diagnostic code is optional for Restart Request Packet. The restarting cause is defined in X.25 {Table 20/X.25}.

4.2.2.9 RESTART CONFIRMATION PACKET

Once the logical channel is in the Restart Indication state the Restart Confirmation Packet is sent to indicate a "Ready" state. Confirmation must be received before expiration of the timer in subsection 4.2.2.8. The packet format for Restart Confirmation Packet is as follows:

	DTE and DCE RESTART CONFIRMATION PACKET FORMAT							
	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier							
	1	1	1	1	1	1	1	1

4.2.2.10 REJECT PACKETS

The Reject (REJ) packet allows a station to request re-transmission of one or several data packets. Upon receipt of a Reject packet from a "Ready" circuit, a station should re-transmit all previously-sent data packets for the specified circuit which remain unacknowledged by P(r) of the REJ packet (i.e., P(r),..., P(s-1)).

The NWSTG host will send a REJ packet if a packet sequence exception is detected. The remote (receiving) station (NCF) may now begin transmitting data packets, starting with P(s) = P(r){REJ}. Only one Reject packet may be outstanding at one time or a procedure error will cause a reset to occur. The format for the REJ Packet is depicted below.

DTE RJE PACKET FORMAT

	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1	0	0	0	0
2	Logical channel number							
3	P(R)				Packet type identifier			
					0	1	0	0	1

4.2.2.11 DIAGNOSTIC PACKET

A Diagnostic Packet is transmitted to indicate an error condition which is not recoverable at the Network Layer. This packet is intended for informational purposes only and does not require confirmation. The format for the Diagnostic Packet is as follows:

Diagnostic Packet Format

Diagnostic code and explanation are given in X.25 {5.6.1, 5.6.2} respectively and X.25 {Annex E}.

	DIAGNOSTIC PACKET FORMAT							
	Bits							
	8	7	6	5	4	3	2	1
1	General format identifier							
	0	0	0	1	0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier							
	1	1	1	1	0	0	0	1
4	Diagnostic code							
5	Diagnostic explanation							

4.2.2.12 PACKET SUMMARY

The table presented below list all X.25 packets that are supported by the NWSTG' implementation of X.25 - 1988.

PACKET TYPE IDENTIFIER									
Packet Type		Bits							
From DCE to DTE	From DTE to DCE	8	7	6	5	4	3	2	1
Data and Interrupt									
DCE data	DTE data	X	X	X	X	X	X	X	0
DCE interrupt	DTE interrupt	0	0	1	0	0	0	1	1
DCE interrupt confirmation	DTE interrupt confirmation	0	0	1	0	0	1	1	1
Flow Control and Reset									
DCE RR (modulo 8)	DTE RR	X	X	X	0	0	0	0	1
DCE RNR (modulo 8)	DTE RNR	X	X	X	0	0	1	0	1
	DTE REJ	X	X	X	0	1	0	0	1
Reset indication	Reset request	0	0	0	1	1	0	1	1
DCE reset confirmation	DTE reset confirmation	0	0	0	1	1	1	1	1
Restart									
Restart indication	Restart request	1	1	1	1	1	0	1	1
DCE restart confirmation	DTE restart confirmation	1	1	1	1	1	1	1	1

Diagnostic								
Diagnostic	1	1	1	1	0	0	0	1

4.2.3 IMPLEMENTATION INFORMATION

Permanent Virtual Circuits must be established to receive NWSTG products and messages. As in standard Permanent Virtual Circuit (PVC) implementation, the Logical Channel Group Number (LCG#) and Logical Channel Number (CKT#) are predefined. Circuit definition and description is shown as follows:

64Kbp/s Physical Circuit 1

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Collection Platform Data (ASCII) and BUFR Data
0	2	ASCII Data Text Files (Low Priority)
0	3	Pictorial Data (Red Book)
0	4	ASCII Data Text Files (High Priority)
0	5	Lightning Data (ASCII)

256Kbp/s Physical Circuit 2 (Not active Once High Speed Interface is Implemented)

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	GRIB and BUFR Data
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

56Kbp/s Physical Circuit 3

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Type Will Be Assigned When PVC Is Setup
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

56Kbp/s Physical Circuit 4

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Type Will Be Assigned When PVC Is Setup
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

56Kbp/s Physical Circuit 5

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Type Will Be Assigned When PVC Is Setup
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

56Kbp/s Physical Circuit 6

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Type Will Be Assigned When PVC Is Setup
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

56Kbp/s Physical Circuit 7

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Type Will Be Assigned When PVC Is Setup
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

56Kbp/s Physical Circuit 8

LCG	PVC	Description
0	0	Used for Restart and Diagnostics
0	1	Data Type Will Be Assigned When PVC Is Setup
0	2	Data Type Will Be Assigned When PVC Is Setup
0	3	Data Type Will Be Assigned When PVC Is Setup
0	4	Data Type Will Be Assigned When PVC Is Setup

All packets have equal priority with the exception of CKT 0, that is used for restart and diagnostic procedures.

4.2.3.1 CIRCUIT ESTABLISHMENT

Upon Data Link entrance to Information Transfer State (ITS), the remote station logical DTE) may request circuit establishment. A desire to open the circuits is conveyed by executing of the restart procedures in X.25 {3.3} for LCG 0, placing the channel group in Data Transfer State (DTS).

4.2.3.2 CIRCUIT TERMINATION

The NWSTG circuits are quasi-permanent in that the LCG and LCN are predefined and the host will never close a circuit from the Network Level. NWSTG host invoke circuit termination by means of a Data Link disconnect request. The subsequent departure from Data Link ITS causes simultaneous closing of all PVCs for the disconnected link. The NCF may close circuits via Data Link disconnection.

5.0 TRANSPORT LAYER

The transport layer's (Layer IV of the OSI Model) primary responsibility is for the end-to-end transport of data from host to host. The transport layer might map multiple "sessions" into a single network connection or map a single session to multiple network connections. This layer isolates the upper layers from hardware/software changes that may occur at the lower layers. It also assumes responsibility for host-to-host acknowledgements of data sent/received by the communicating hosts. Currently the NWSTG does not support the transport layer.

6.0 SESSION LAYER

The session layer (Layer V of the OSI Model) is responsible for initiating "connections" between two or more users that desire to communicate. The session represents the user/application in invoking the lower communications layers. Above the session layer, the user can be considered a single entity, or stand-alone system. Once the user or application invokes a session, it becomes a participant in a system of several or many applications components or networks. Currently the NWSTG does not support the session layer.

7.0 PRESENTATION LAYER

The presentation layer (Layer VI of the OSI Model) is primarily concerned with data transformation functions needed such that data can be interpreted by applications residing in multiple environments. Specifically, this includes functions such as character code conversion (e.g., ASCII to EBCDIC), encryption or text compression, terminal emulation and code form interpretation.

7.1 COMMUNICATION CONTROL BLOCK (CCB)

7.2 INTRODUCTION

The CCB provides a capability for the immediate switching of incoming information and multiple addressing of products. The multiple addressing capability is needed when more than one switching center in a chain of multiple, serially connected centers requires the same information.

7.3 CCB USE

The CCB is a header block (Figure 7-1) in the information part of the transmission, and is designed to implement the ability to define the data type, classification, precedence, and routing requirements.

The design of the CCB provides for the introduction of various data formats and/or code forms on the Inter-departmental Meteorologicical Data Exchange System (IMDES). The recipient of the message can determine from the CCB the proper host processing

requirements. The CCB follows the X.25 Network Layer (first 3 bytes in the I-Frame) for the first packet of an NWSTG product and conforms to the Green Book, FCM-S3-1991, Standard Telecommunications Procedures For Weather Data Exchange, October 1991, structure.

7.4 CCB CONTENT

The contents of the CCB is as follows:

FF: A two-bit flag which specifies length and no checksum (for compliance with Green Book, FCM-S3-1991, is used). Its value in the CCB is always 01.

CCB LENGTH: A 14-bit binary integer specifying the number of byte pairs in the CCB. Bytes are transmitted low order bit first.

MODE/SUBMODE: This designation for a product data category structure is used to maintain consistency with the convention used in the Green Book, FCM-S3-1991.

PRECEDENCE: One ANSI X3.4-1986 (7-bit) character defined for the following values:

R = routine
P = priority
O = operations immediate
Z = flash

COMMUNICATION CONTROL BLOCK MODE 0 SUBMODE 1	
FF	CCB LENGTH
MODE (0)	SUBMODE (1)
PRECEDENCE	CLASSIFICATION
MESSAGE ORIGINATOR	
IDENTIFICATION	
CATEGORY	SUBCATEGORY
USER DEFINED	USER DEFINED
(YEAR)	MONTH
(TOR DAY)	(TOR HOUR)
(TOR MINUTE)	# of DESTINATIONS
MESSAGE DESTINATION	
IDENTIFICATION 1	
MESSAGE DESTINATION	
IDENTIFICATION 2	
MESSAGE DESTINATION	
IDENTIFICATION 3	
:	:
:	
MESSAGE DESTINATION	
IDENTIFICATION n	

Figure 7-1

CLASSIFICATION: One ANSI X3.4-1986 (7-bit) character defined for the following values:

U = unclassified
C = confidential
S = secret
T = top secret

E = encrypt for transmission only (EFTO)

MESSAGE ORIGINATOR IDENTIFICATION: The International Civil Aviation Organization (ICAO) identification of the communications center where this information was assembled for transmission, not the origin of the message content. This field is 4 bytes long.

CATEGORY: The data format definition as shown in Table 7.1.

SUBCATEGORY: A further definition of the category as shown in Table 7.2.

YEAR: The year the product was generated (in binary).

MONTH: The month the product was generated (in binary).

TOR: Time of receipt at the last center expressed in three 8-bit binary integers (use only the 6 low order bits) as follows:

TOR = an 8-bit byte equal to day of month 1-31
TOR HOUR = an 8-bit byte equal to hour of day 00-23
TOR MINUTE = an 8-bit byte equal to minute of hour 00-59

The following field is optionally filled with zero

# of DESTINATIONS: A packed-decimal value equal to the number of 4 byte ICAO message destination identification addresses that follow in the CCB.

MESSAGE DESTINATION IDENTIFICATION: (I to n) 4-byte ICAO identifiers (7-bit ASCII) of stations to receive the product which follows. Precede all Station Identifiers which are less than four characters with, ASCII blanks.

TABLE 7.1
CATEGORY OF PRODUCTS
FOR THE
COMMUNICATIONS CONTROL BLOCK

CATEGORY	DEFINITION
0	Undefined category for following information
1	Product information format is defined in FCM-S2
2	Product is in a WMO Standard code form
03 - 19	(to be assigned by Working Group/Communications Interfaces and Data Exchange (WG/CIDE)
20 - 39	USAF control for assignment
40 - 59	US Navy control for assignment
60 - 79	NWS control for assignment
80 - 99	FAA control for assignment
100 - 255	(Reserved)

Table 7.2
SUBCATEGORY of Products

CATEGORY	SUBCATEGORY	DEFINITION
0	0 - 255	Reserved
1 (FCM-S2)	0	Reserved
	1	Systems Product Data
	2 - 9	Open (assigned by WG/CIDE)
	10	Alphanumeric Product Data
	11 - 29	Open (assigned by WG/CIDE)
	30	Vector Graphics Product Data
	31 - 39	Open (assigned by WG/CIDE)
	40	Raster Product Data'
	41 - 59	Open (assigned by WG/CIDE)
	60	Packed Gridded Data
	61 - 79	Open (assigned by WG/CIDE)
	80	Unpacked Gridded Data
	81 - 99	Open (assigned by WG/CIDE)
	100	Formatted Binary Product Data
	101 - 199	Open (assigned by WG/CIDE)
	200 - 254	(Not yet assigned)
	255	Test
2 (WMO)	0	ASCII data code forms
	1	WMO GRIB code forms
	2	WMO BUFR code forms
	3	WMO facsimile digital data
	4	WMO facsimile coded digital data
	5 - 254	(Not yet assigned)
	55	Test
3 - 19	0 - 254	(Assigned by WG/CIDE)
	255	Test
20 - 39	0 - 254	(Assigned by the US Air Force)
	255	Test
40- 59	0 - 254	(Assigned by the US Navy)
	255	Test
60 (UTF)	0	(Assigned by the NWS)
	1	AFOS graphics
	2 - 254	(Assigned by the NWS)
	255	Test
61 (FMH)	0	SAO aviation hourly
	1 - 254	(Assigned by the NWS)
	255	Test
62 - 79	0 - 254	(Assigned by the NWS)
	255	Test

80 - 99	0 - 254	(Assigned by the FAA)
	255	Test
100 - 254	0 - 254	(Reserved)
	255	Test
255	0 - 255	Test

8.0 STANDARD FORMATS USED BY THE NWSTG FOR PRODUCT DISSEMINATION

8.1 STANDARD FORMATS FOR WEATHER DATA EXCHANGE - RED BOOK

The Standard Format for Weather Data Exchange Among Automated Weather Information Systems follows the Federal Standard FCM-S2-1990, to present a common set of formats used for the presentation of weather data among Federal Agencies. These formats included in the document meets the requirements of the National Weather Service, U.S. Air Force, U.S. Navy, and the Federal Aviation Administration. These formats provide a data structure that is not dependent on network or data link procedures, and will support products and messages, both graphic and nongraphic.

Federal Standards, Red Book, FCM-S2-1990, manual should be consulted for explicit details on the use and implementation of these formats.

8.2 GRIDDED BINARY FORMAT (GRIB)

GRIB follows the World Meteorological Organization (WMO) Standard that provides an efficient vehicle for transmitting large volumes of gridded data to automated systems over high speed telecommunications lines using modern protocols. By packing information into the GRIB code, messages can be made more compact than character oriented bulletins, producing faster computer-to- computer transmissions. GRIB can be equally well serve as a data storage format, generating the same efficiencies related to information storage and retrieval devices.

Each GRIB record intended for either transmission or storage contains a gridpoint field, or set of spectral coefficients, for a single parameter at a single level or layer as a continuous bit string. Logical subdivision of the record are designated as "sections," each of which provide control information and/or data. A GRIB Record consists of six sections listed below.

1. Indicator Section, includes edition of number
2. Product Definition Section
3. Grid Description Section - optional
4. Bit Map Section - optional
5. Binary Data Section
6. `7777' in ASCII Characters

For explicit details on the use and implementation of GRIB consult the WMO, GRIB User Manual, WMO Code FM-92-VIII Ext.

8.3 BINARY UNIVERSAL FORM FOR REPRESENTATION (BUFR)

BUFR follows the WMO Standard to provide a universal data representation form, capable of representing any numerical or even qualitative information of any kind and is not unique to meteorological data applications. BUFR makes quite efficient use of space by virtue of its use of binary numbers that take up only as many bits as are necessary to hold the largest expected value. A typical BUFR message is divided into logical sections without any special characters or bit configurations to separate them. The contents are described in sections one through six as follows:

1. BUFR in ASCII Characters, Length of Message, Edition Number
2. Identification
3. Optional (local use)
4. Data Descriptors
5. Data
6. `7777' in ASCII Characters

For explicit details on the use and implementation of BUFR consult the WMO, BUFR User Manual, WMO FM 94 BUFR-IX.

9.0 PRODUCT STRUCTURE

There are two major parts to each independent piece of data as it is transferred across the interface: (1) the product identification and (2) the product. The product identification is a block(s) of information necessary to route the product to an appropriate processor at the receiving site. This includes product attributes such as the location or area covered as well as a product identifier. The product may be thought of as a file (or a data set); it is an independent set of information in a known format containing individual pieces or collections of hydrometeorological information. These two parts are depicted below.

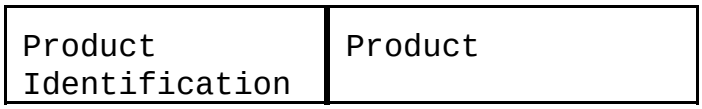


Figure 9.1 Overview of Product Content

9.1 PRODUCT IDENTIFICATION

9.1.1 NWSTG INTERFACE PRODUCT IDENTIFICATION

AWIPS products provided to the Contractor through the NWSTG interface will use the World Meteorological Organization (WMO) abbreviated heading for product identification. This product identification scheme is described in the WMO Manual on the Global Telecommunication System (GTS), WMO Publication No. 386, under Part II - Operational procedures for the Global Telecommunication System.

The WMO abbreviated heading format is summarized below. The specific application of the WMO abbreviated heading format for graphics, grid data, point data, and free text products are provided in the following subsections.

Note: The WMO abbreviated heading alone will not provide the uniqueness required for identification of all products stored on site. Unique identification of each product will require accessing further information contained in: (1) the Product Definition Section (PDS) of grid data; (2) the Product Identification Block and Product Definition Block of graphics data; (3) the identification section of point data in BUFR format; or (4) site identifiers contained in text product bulletins (collectives). (See the GRIB, RED BOOK, BUFR, and WMO documents for more information on these product identification formats.)

The WMO abbreviated heading will have the following format in ASCII character form:

$T_1T_2A_1A_2$ii (sp) CCCC (sp) YYGGgg [(sp)BBB] (cr)(cr)(lf)

The symbols have the following meanings:

$T_1T_2A_1A_2ii$ - Data Designators, defined in Tables 9.1 through 9.4

T_1T_2 - Data type and/or form designators.

A_1A_2 - Geographical and/or time designators.

ii - Number used to differentiate two or more bulletins which contain data in the same code and which originate from the geographical area and have the same originating center. It will be a number with two digits. For products that are not raw data bulletins, the "ii" may provide height level or other special product designators as defined in Table 9.1 which follows.

(sp) space

CCCC - International four-letter location indicator of the station originating or compiling the bulletin as agreed bilaterally or multilaterally, and published in WMO Publication No. 9, Volume C, Chapter 1, Catalogue of Meteorological Bulletins.

YGGgg - International date-time group.

YY - Day of month.

GGgg - For bulletins containing meteorological reports the time will be the standard time of observation Universal Time Coordinates (UTC).

- For aerodome, route, and area (aeronautical) forecasts: the full hour in UTC (the last two digits will be 00) preceding the transmission time; for other forecasts and analyses: standard time of observation in UTC on which forecast or analysis is based.

- For other messages, the time will be the time of origin in UTC.

BBB - An abbreviated heading defined by $T_1T_2A_1A_2ii$ CCCC YYGGgg will be used only once. The indicator BBB should only be included in the

abbreviated headings of delayed, corrected, or amended bulletins, or for sequential parts of long messages. When the BBB indicator is not included, the CRCRLF immediately follows the date/time group. Consequently, if this abbreviated heading has to be used again for an addition, a correction, an amendment, or sequential parts of long messages, it will be mandatory to add appropriate BBB indicator, identified by a three-letter indicator which will be added after the date-time group. The indicator BBB will have the following form (a), (b), or (c) as defined below:

(a) RRx - for delayed routine meteorological reports;
CCx - for corrections to previously relayed reports;
AAx - for amendments to processed information where x is an alphabetic character of "A" through "X."

(b) RTD - for delayed routine meteorological reports;
COR - for corrections to previously relayed reports;
AMD - for amendments to processed information.

(c) Pxx - for sequential parts of long messages that have been divided using the BLOK feature, where xx = AA-ZZ inclusive. See Note 1 below.

(CR) Carriage return
(LF) Line Feed

The WMO abbreviated heading will precede the data but follow the NWSTG Communications Control Block for all products, i.e., graphics products, grid products, point data, and free text products to be provided through the NWSTG interface. The WMO abbreviated heading will be contained in a 21-character WMO header block (or 25 characters if a BBB indicator is included). This block structure is defined in Appendix A, Page A.1, of the

Gridded Binary Format, WMO Code FM-92-VIII Ext, June 3, 1991, document.

NOTES:

1. All products delivered over the NWSTG interface will end with the standard 4-byte WMO end of message of <CR> <CR> <LF> <ETX> as described in WMO Manual on the GTS, WMO Publication No. 386, Part II 2.3.4 (b) International Alphabet No. 5. The <CR> <CR> <LF> <ETX> end of message bytes will also follow each part of long messages that the NWSTG has broken into parts for data communications purposes, see Note 2 following.

2. The NWSTG will divide large products (currently those in excess of approximately 15-Kbytes), such as grids and text products, into several parts for data communications purposes. The first part will have a BBB group of PAA, the second PAB, through PAY, PAZ, PBA until the last segment which will have a PZx, where x is the next letter in the sequence of the third character. For example, a three part message will have the first part labeled with a BBB of PAA, the second PAB, and the third and last as PZC.

   Currently large graphics are segmented into parts at the NSC. The segmentation is indicated in the 2-byte "USER DEFINED" portion of the CCB (see Figure 7-1 of the Green Book, FCM-S3-1991). The first byte identifies the segment number of the product. The second byte indicates the total number of product segments to be sent. At a future date, this graphic product segmentation scheme may be discontinued, and the large graphic products may be broken into parts at the NWSTG and use the same BBB convention of the WMO header described above. |

   The NCF will need to reassemble the multipart messages received from the NWSTG into a single product prior to transmission on the SBN. In reassembling multipart messages, the NCF will need to remove the 4 WMO end of message bytes

(<CR> <CR> <LF> <ETX>) from each intermediate part, so that the reassembled message has only the WMO end of message bytes (<CR> <CR> <LF> <ETX>) at the end of the reassembled message.

3. When the NWSTG is providing limited backup data operations for NSC, the WMO abbreviated heading of a product will not change except possibly the last four characters of the CCCC (Station Originator) following the $T_1T_2A_1A_2ii$.

4. The WMO abbreviated heading ($T_1T_2A_1A_2ii$) character identifiers defined in Sections 9.1.1 and 9.1.2 are subject to change. Character assignments may change and subtables may be defined to best accommodate the AWIPS product identification needs.

9.1.1.1 GRAPHIC PRODUCT IDENTIFICATION

The first character of the WMO abbreviated heading (product identifier $T_1T_2A_1A_2ii$) for graphic products is always the letter P, i.e., T_1 = P for all graphics. The designators for the other characters (i.e., T_2, A_1, A_2, and ii) for graphics products are shown in Tables 9.1 through 9.4 below. Due to the large size of graphics products, they will be segmented for communications purposes. Each segment will be numbered in the CCB. The first segment will contain the WMO Header. A separate and unique 15 character product identifier will be provided as part of the Product Identification Block, following the WMO abbreviated heading in the first segment only of each RED BOOK graphics.

9.1.1.2 GRID PRODUCT IDENTIFICATION

The first character of the WMO abbreviated heading (product identifier $T_1T_2A_1A_2ii$) for grid products is always the letter Y, Z, or O, i.e., T_1 = Y or Z or O or H for all Grid Data. The designators for the characters of the WMO abbreviated heading are shown in Appendix A of the Gridded Binary Format, WMO Code FM-92-VIII Ext, June 3, 1991, document.

9.1.1.3 POINT DATA IDENTIFICATION

The first character of the WMO abbreviated heading (product identifier $T_1T_2A_1A_2ii$) for Point Data transmitted in BUFR code is

always the letter I for Observations and J for Forecasts, i.e., T_1 = I for all BUFR Observations and T_1 = J for all BUFR Forecasts. See Tables 9.5, 9.6, and 9.7 for the other characters in the WMO abbreviated heading.

9.1.1.4 FREE TEXT PRODUCT IDENTIFICATION

The first character of the WMO abbreviated heading (product identifier ($T_1T_2A_1A_2$ii) for free-form text products is the letter A for Analyses, B for Addressed (Administrative) Messages, C for Climatic Data, F for Forecasts, N for Notices, S for Surface, and W for Watches and Warnings.

The WMO abbreviated headings for free-form text products are derived from Table A, Table B1, and Table C from the WMO manual on the GTS (Pub. 386) Attachment II-6.

Table 9.1 WMO Abbreviated Heading - T_2 for Graphics

	Designator	Parameter
T_2 =	A	Radar Data
	B	Vertical Wind Shear
	C	Vorticity
	D	Thickness
	E	Precipitation
	F	Flight Level Heights
	G	Significant Weather
	H	Height (Geopotential)
	I	Open
	J	TDL Products
	K	Ocean Products
	L	Open
	M	Open
	N	Severe Storm Product
	O	Vertical Velocity
	P	Pressure
	Q	Open
	R	Relative Humidity
	S	Open
	T	Temperature
	U	Open
	V	Open
	W	Wind
	X	Lifted Index and Stability Index
	Y	Miscellaneous Graphics
	Z	Wind at constant elevation

Note the Snow Products are moved from "S" to the "E" Precipitation Parameter. There are only two snow products:
Observation Snow Cover (POS)
12 Hour Heavy Snow Forecast (93S).

Table 9.2 WMO Abbreviated Heading - A_1 for Graphics

Designator		Geographical Area
A_1 =	A	
	B	Statistical Blending
	C	
	D	RESERVED FOR
	E	FUTURE USE,
	F	E.G., MESOSCALE
	G	(ETA) MODEL
	H	Manual, Northern Hemisphere
	I	Manual, CONUS (Super National)
	V	Non-model, Northern Hemisphere
	W	Non-model, CONUS (Super National)
	Y	ECMWF, Northern Hemisphere
	Z	UKMO, Northern Hemisphere

- MRF Model and Other Graphics

J - National
K - Northern Hemisphere

- RAFS Models

L - Puerto Rico (National Product)
M - CONUS (National Product)
N - Hawaii (National Product)
O - Alaska (National Product)

- Aviation Model Products (AVN)

P - Eastern Hemisphere, Southern Hemisphere, Pacific, Atlantic
Q - Northern Hemisphere
R - Puerto Rico (National Product)
S - CONUS (National Product)
T - Hawaii (National Product)
U - Alaska (National Product)
X -Miscellaneous or No Geographic Area

NOTE: Each graphic product will have sufficient information sent with it for its location, size, orientation, and pixel resolution to be determined.

Table 9.3 WMO Abbreviated Heading - A_2 for Graphics

	Designator	Forecast Hour
A_2 =	A	0 hour (analysis)
	B	6 hour forecast
	C	12 " "
	D	18 " "
	E	24 " "
	F	30 " "
	G	36 " "
	H	42 " "
	I	48 " "
	J	60 " "
	K	72 " "
	L	84 " "
	M	96 " "
	N	108 " "
	O	120 " "
	P	132 " "
	Q	144 " "
	R	156 " "
	S	168 " "
	T	180 " "
	U	192 " "
	V	204 " "
	W	216 " "
	X	228 " "
	Y	240 " "
	Z	00 hour (initialized)
	0	02 " forecast
	1	04 " "
	2	08 " "
	3	10 " "
	4	14 " "
	5	16 " "
	6	20 " "
	7	22 " "
	8	54 " "
	9	66 " "

Table 9.4 WMO Abbreviated Heading - ii for Graphics

When T_2 = Z (Winds at 1000's feet ii)
Then ili2 = Number of thousands of feet

When T_2 = N (Severe Storm Graphics)
Then ili2 = 41 Watches Warning & Advis. 1st Period (CD1)
Then ili2 = 42 Watches Warning & Advis. 2nd Period (CD2)
Then ili2 = 43 Watches Warning & Advis. 3rd Period (CD3)
Then ili2 = 44-53 Alerts, Warning, Advisories & Watches
Then ili2 = 60 Lightning Detection Summary (LDS)
Then ili2 = 61-69 Severe Weather Depictions
Then ili2 = 70-89 Other

When T_2 = E (Precipitation)
Then ili2 = 31 24 Hour Observed Precipitation (POP)
Then ili2 = 32 Observed Snow Cover (POS)
Then ili2 = 33 12 hour Heavy Snow (93S)
Then ili2 = 34 Precipitable Water Plot (PO3)
Then ili2 = 35 Precipitable Water Analysis (IOP)
Then ili2 = 41 24hr Day 1 QPF (94Q)
Then ili2 = 42 24hr Day 2 QPF (98Q)
Then ili2 = 43 06hr QPF - PD1 (92E)
Then ili2 = 44 06hr QPF - PD2 (93E)
Then ili2 = 45 Excessive Rain Outlook (94E)
Then ili2 = 46 5 Day Total Precipitation (95E)
Then ili2 = 47 6-10 Day Total Precipitation (96E)
Then i1i2 = 48 30 Day Precipitation Anomaly (9ME)
Then ili2 = 49 3 Month Avg Precipitation Anomaly (99P)
Then ili2 = 61 12hr Instant Precipitation (L2P)
Then ili2 = 62 24hr Instant Precipitation (L4P)
Then ili2 = 63 36hr Cloud and Precipitation (L6P)
Then ili2 = 64 48hr Cloud and Precipitation (L8P)

When T_2 = G (Significant Weather)
Then ili2 = 31 Observed Weather Depiction Plot (POW)
Then ili2 = 32 Observed Weather Depiction Analysis (9OW)
Then ili2 = 39 Central U S Satellite SIM (CMS)
Then ili2 = 41 Pacific Satellite SIM (IPG)
Then ili2 = 42 12hr Weather Depiction Low (L2W)
Then ili2 = 43 24hr Weather Depiction Low (L4W)
Then ili2 = 44 2-6hr Thunderstorm Prob (01G)

Then ili2 = 45 2-6hr Thunderstorm Prob (01O)
Then ili2 = 46 Convective Outlook Day 1 (940)
Then ili2 = 47 Convective Outlook Day 2 (980)

Table 9.4 WMO Abbreviated Heading - ii for Graphics (Cont'd)

When T_2 = T (Temperature)
Then ili2 = 31 Observed Max Temperature -12 Hr Plot (P0X)
Then ili2 = 32 Observed Min Temperature -12 Hr Plot (P0N)
Then ili2 = 33 Normal Max Temperature Anal 3-5 Day (90X)
Then ili2 = 34 Normal Min Temperature Anal 3-5 Day (90N)
Then ili2 = 48 30 Day Temperature Anomaly (9MT)
Then ili2 = 49 3 Month Avg Temperature Anomaly (99T)
Then ili2 = 51 6-10 Day Temperature Anomaly (96T)
Then ili2 = 52 5 Day Max Temperature Anomaly (95A)
Then ili2 = 53 5 Day Max Temperature Anomaly (95B)

When T_2 = Y (Miscellaneous)
Then ili2 = 31 Surface Geostrophic Wind Plot (9AM)
Then ili2 = 32 Surface Geostrophic Vorticity (9AV)
Then ili2 = 43 Day3 Max/Min Temp and Prob of Precip (93P)
Then ili2 = 44 Day4 Max/Min Temp and Prob of Precip (94P)
Then ili2 = 45 Day5 Max/Min Temp and Prob of Precip (95P)
Then ili2 = 46 Drought/Wet Index (6KA)
Then ili2 = 47 Croup Moisture Index (6KB)
Then ili2 = 52 5 Day Max Temperature Anomaly (95A)
Then ili2 = 53 5 Day Min Temperature Anomaly (95B)
Then ili2 = 61 6hr Low Level Moisture Convergence (L1Z)
Then ili2 = 62 12hr Low Level Moisture Convergence (L2Z)
Then ili2 = 63 18hr Low Level Moisture Convergence (L3Z)
Then ili2 = 64 24hr Low Level Moisture Convergence (L4Z)

Note: 90N, 90R, 90S, 90W, 90X, 92E, 93E, 93P, 93S, 940, 94E, 94P, 94Q, 95A, 95B, 95E, 95P, 96E, 96T, 98O, 98Q, 9AM, 9AV, CD1, CD2, CD3, CMS, IOP, LDS, LOA, LOF, L1Z, L2P, L2Z, L3Z, L4P, L4Z, L6P, L8P, PO3, PON, POP, POS, POW, POX, 6KA, 6KB, 01G, and 01O are AFOS Product IDS.

Table 9.4 WMO Abbreviated Heading - ii for Graphics (Cont'd)

When T_2 =	All Other Letters
Then i1i2 =	00 High-Level Aviation
	01 Sea Level
	02-90 Level of Atmosphere (x10) in Hectopascals (hPa)
	91 Low-Level Aviation
	92 Boundary Layer
	93 Land/Water Properties at Surface of Earth
	94 Level of 0 deg Centigrade Isotherm
	95 950 hPa Level
	96 Level of Maximum Wind
	97 Level of Troposphere
	98 Air Properties at Surface of Earth or Ocean
	99 1000 hPa Level
	Blank Not Applicable

Table 9.5 WMO Abbreviated Heading - T_2 for Point Data (BUFR Code)

For T_1 = I (Observations)

T_2 =	O	Oceanographic/Limnographic (water properties)
	P	Pictorial
	S	Surface/Sea Level (air properties)
	T	Text (Plain Language Information, Sundry Messages, etc.)
	U	Upper Air
	X	Other Types of Observations
	Z	Mixed Types of Observations

For T_1 = J (Forecasts)

T_2 =	O	Oceanographic/Limnographic (water properties)
	P	Pictorial
	S	Surface/Sea Level (air properties)
	T	Text (Warnings, etc.)
	U	Upper Air
	X	Other Types of Forecasts
	Z	Mixed Types of Forecasts

Table 9.6 WMO Abbreviated Heading - A_1 for Point Data (BUFR Code)

For T_1 = I (Observations) and T_2 = S (Surface)

A_1 =	A	Hourlies (airways)
	C	Climatic
	I	Land-Based Synoptic reports at intermediate reporting times
	M	Land-Based Synoptic reports at main reporting times
	N	Land-Based Synoptic reports at non-standard reporting times
	P	Specials (airways)
	R	Hydrologic
	S	Floating Platform (ship, buoy, etc.)
	X	Other Surface Data
	Z	Mixed collection of reports

For T_1 = I (Observations) and T_2 = U (Upper Air)

A_1 =	A	Single Level (aircraft)
	B	Single Level (balloon)
	C	Single Level (satellite)
	D	Soundings (dropsondes/dropwindsondes)
	N	Soundings (rocketsondes)
	P	Soundings (profilers)
	S	Soundings (radiosondes/pibals)
	T	Soundings (satellite derived)
	X	Other upper air
	Z	Mixed collection of reports

For T_1 = I (Observations) and T_2 = O (Oceanographic/Limnographic)

A_1 =	I	Ice
	S	Soundings from surface on down
	T	Surface Temperatures
	W	Surface Waves
	X	Other
	Z	Mixed collection of reports

For T_1 = I (Observations) and T_2 = P (Pictorial)

A_1 = I Satellite Imagery
R Radar
X Other
Z Mixed collection of reports

Table 9.6 (continued)

For T_1 = J (Forecasts) and T_2 = S (Surface)

A_1 =	A	Surface Area Forecast (e.g., airways)
	M	Surface Forecasts (e.g., MOS)
	P	Forecast Amendments
	R	Hydrologic Forecasts
	T	Aerodrome Forecasts
	X	Other Surface Forecasts
	Z	Mixed collection of forecasts

For T_1 = J (Forecasts) and T_2 = U (Upper Air)

A_1 =	A	Forecast at Single Level
	S	Forecast Soundings
	X	Other Upper Air Forecasts
	Z	Mixed collection of forecasts

For T_1 = J (Forecasts) and T_2 = O (Oceanographic/Limnographic)

A_1 =	I	Ice
	S	Soundings from surface on down
	T	Surface Temperatures
	W	Surface Waves
	X	Other
	Z	Mixed collection of forecasts

Table 9.7 WMO Abbreviated Heading - A_2 and ii for Point Data (BUFR Code)

A_2 = Table C3 from the WMO Manual on the GTS (Pub. 386) Attachment II-6
= X Multiple areas or no particular area

ii = Two character sequence number, 00-99, used only to distinguish multiple bulletins from the same originating center with similar content and the same date.

9.2 AWIPS PRODUCT IDENTIFICATION

The following AWIPS product identification scheme meets the requirements to (1) use a valid WMO abbreviated heading that conforms with international practices; (2) provide an AWIPS Identifier that is unique; and (3) accommodates the AFOS message structures.

9.2.1 AWIPS IDENTIFIER (AI)

All free form ASCII format text information and data originating at AWIPS sites and transmitted over the AWIPS network should be uniquely identified with an AWIPS Identifier (AI). The purpose of the AI is to provide a method, common to all sites, of recognizing the contents of ASCII text messages such that a receiving site can take appropriate action.

This AI requirement does not encompass grid data, graphics, or point data in BUFR format. The additional information about each of these product types required to store the product in a data base is available in separate data blocks following the WMO abbreviated heading.

The AI is composed of 8-10 characters in the following format:

CCCCNNNxxx

CCCC: The 4-letter CCCC (originating office) should be identical to the CCCC portion of the WMO abbreviated heading, $T_1T_2A_1A_2ii$

(sp) CCCC (sp) YYGGgg [(sp)BBB] (cr)(cr)(lf). The CCCC should be the valid International Civil Aviation Organization (ICAO)-approved identifier of the office originating the product (refer to ICAO Doc 7910, Location Indicators). The first character should be K for the CONUS offices followed by the 3-letter FAA identifier. For offices outside the CONUS, the first two characters should be PA for Alaska, PH for Hawaii, and TJ for Puerto Rico followed by an additional two characters unique to the site. Additional CCCC's apply to products that originate outside the U.S. The 3-letter AFOS node identifier is no longer valid in the AWIPS environment and will not appear in the AWIPS headings.

NNN: The 3-character NNN (product category) should be identical to the AFOS NNN. Note, after the transition from AFOS is complete, the number of characters of the product category may be increased, if required. The AWIPS software should be flexible to allow future expansion in the number of characters in the product category.

xxx: The 1-3 character xxx (product designator) should be identical to the AFOS xxx. If the xxx is less than 3 characters, the character(s) should be left justified and filled with blanks to complete the 3-character field. Note, after the transition from AFOS is complete, the number of allowable characters of the product designator may be increased if required, e.g., to accommodate 5-character product designators of sites. The AWIPS software should be flexible to allow future expansion in the number of characters in the product designator.

Prior to the First Article Factory Acceptance Test, the government will furnish a listing of all products delivered from the NWSTG interface by WMO abbreviated heading as well as the necessary information on the CCCC, NNN, and xxx portions of the AI to implement the product identification scheme.

9.2.1.1 COMBINED WMO ABBREVIATED HEADING AND AWIPS IDENTIFIER FOR COMMUNICATION OF PRODUCTS TO AND FROM THE NWSTG

The NWSTG will perform all data format and protocol conversions necessary for the two-way flow of data between the AWIPS contractor's interface and AFOS through the NWSTG. For products originating from AFOS, the NWSTG will combine the WMO abbreviated heading and the AI as follows:

$T_1T_2A_1A_2$ii (sp) CCCC (sp) YYGGgg [(sp)BBB] (cr)(cr)(lf)
NNNxxx (cr)(cr)(lf)

The NNNxxx of the AI becomes the first line below the WMO abbreviated heading. Note, the CCCC portion of the AI does not appear in the second line with the NNNxxx since the identical CCCC is contained in the WMO abbreviated heading in the line above.

For products received from AFOS at the NWSTG destined for AWIPS, the NWSTG will delete the AFOS product identifier, insert the valid WMO abbreviated heading (as is done today), and insert the NNNxxx as the first line of text immediately below the WMO abbreviated heading (as shown in the format above).

Products originating from AWIPS should be transmitted with the combined valid WMO abbreviated heading and NNNxxx in the format shown above. The NWSTG will translate the AWIPS-originated product heading for AFOS (placing the AFOS heading as the first line of text followed by the WMO abbreviated heading line, and the NNNxxx line removed), but for all other circuit distribution the AWIPS-originated product heading will remain unchanged.

Products not originated by the NWS that pass through the NWSTG for distribution to AWIPS, as well as collectives of reports in ASCII text format that are formulated by the NWSTG, will not contain the NNNxxx as the first line of text immediately below the WMO abbreviated heading. Therefore, they will not contain the complete AI as defined above. For these products the text message begins immediately below the WMO abbreviated heading. Within the text itself of such products, there is other information that is useful in fully identifying the product for data basing. In the case of report collectives, each individual report will begin with the location identifier; and for certain product types, the WMO code standards require the text message to begin with a specified $M_iM_iM_jM_j$ group, e.g., TTAA to indicate Part A of an upper air report for the block/station number indicated in the report. For these text products received without the NNNxxx information, the AWIPS software should use the WMO abbreviated heading and the code of the text to uniquely identify the product. For such products, the government will provide the

necessary information to allow the unique product identification at an agreed upon time frame and in an agreed upon format.

9.2.1.2 REALIGNMENT OF WMO ABBREVIATED HEADINGS FOR AWIPS

The NWS' Systems Operations Center, which manages the NWSTG, assigns and maintains the WMO abbreviated headings for NWS products as part of the configuration management process. The WMO abbreviated headings in the NWSTG switching directory require routine maintenance to reflect changes in products or location identifiers, or to conform to changes in the WMO standards.

The NWSTG, in addition to writing additional software to accommodate the combination of the WMO abbreviated heading and the AWIPS Identifier plans to reassign WMO abbreviated headings for AWIPS WFO's so that the ii group of the $T_1T_2A_1A_2$ii is assigned logically. The ii will be assigned by geographic area corresponding to Area Forecast (FA) sectors as shown below.

ii = 40, 50, ... 80	Issued from U.S. Pacific (Honolulu, HI and Guam)
41, 51, ... 81	Issued from Northeast U.S. WFO
42, 52, ... 82	Issued from Southeast U.S. WFO (including San Juan, PR)
43, 53, ... 83	Issued from North Central U.S. WFO
44, 54, ... 84	Issued from South Central U.S. WFO
45, 55, ... 85	Issued from U.S. Rocky Mountains WFO
46, 56, ... 86	Issued from West Coast WFO
47, 57, ... 87	Issued from SE Alaska (Juneau)
48, 58, ... 88	Issued from Central Alaska (Anchorage)
49, 59, ... 89	Issued from NE Alaska (Fairbanks)

Note: Products issued under the CCCC of KWBC (which includes the NSC products distributed through the NWSTG) as well as products issued from the other National Centers will not be required to adhere to the ii logic for WFO issuances. The National Centers may choose to apply the ii logical assignment for their product issuances as appropriate.

The 50's series and on up will be assigned only if there is a need to differentiate among significantly different types of products assigned the same $T_1T_2A_1A_2$, e.g., TAF's and FTA's both assigned FTUS. The NWS will provide substantial advance written

notification to other agencies and external users prior to the implementation of the reassignment of WMO abbreviated headings for existing products.

The following examples are provided to illustrate the AWIPS product identification as specified in this section.

ABUS41 KLWX 272200
SWSDC
[text.....]
State Weather Summary for the District of Columbia issued by WFO Sterling, VA AWIPS Identifier = KLWXSWSDC

FEUS45 KPSR 181642 AAA
LFPPSR
[text.....]
Local Forecast for Phoenix issued by WFO Phoenix, AZ (Amendment number 1) AWIPS Identifier = KPSRLFPPSR

FTUS45 KPSR 220000
TAFPHX
[text.....]
International Terminal Forecast for Phoenix Airport issued by WFO Phoenix, AZ AWIPS Identifier = KPSRTAFPHX

FTUS55 KPSR 111500
FTAPHX
[text.....]
Terminal Forecast for Phoenix Airport issued by WFO Phoenix, AZ AWIPS Identifier = KPSRFTAPHX

USUS10 KWBC 021200
TTAA 52121 72562 ... [remainder of the report]
Upper Air Report - Part A compiled by KWBC (the Washington WMO Regional Telecommunication Hub)

9.2.1.3 AWIPS MESSAGE COMPOSITION AND PRODUCT IDENTIFICATION

The AWIPS operator should be able to compose a message for transmission without knowledge of the WMO abbreviated heading. One option for identifying a product in composition should be for the operator to specify the AI along with the other relevant product information. (No assumptions are made here concerning how this information is entered. The entry of this information can be accomplished through completion of a header block preformat, menu selections, combinations thereof, or other options designed in the user interface.) The AWIPS system should use the specified CCCC (the local office should be the default) as the CCCC portion of the WMO abbreviated heading. The $T_1T_2A_1A_2ii$ should be created from a look-up table that maps the specified NNN portion of the AI to the $T_1T_2A_1A_2ii$. Below is an example of a portion of such a look-up table that includes the example products illustrated in the previous section. The AWIPS system should provide the added capability required to map each valid CCCC to its geographic area.

NNN	**$T_1T_2A_1A_2ii$**
SWS	ABUS4*
LFP	FEUS4*
TAF	FTUS4*
FTA	FTUS5*
SFP	FPUS4*
ZFP	FPUS5*
SWS	ABUS4*
CMM	CSUS4*
CLI	CSUS5*
CLM	CSUS6*
WMD	CSUS7*
SEO	CSUS8*
.	.
.	.
.	.

* indicates this digit is assigned according to Geographic Area

Look-up Table Mapping NNN to WMO $T_1T_2A_1A_2ii$ for AWIPS Field Generated Products

9.2.1.4 AWIPS PRODUCT RETIEVAL AND DISPLAY

AWIPS should provide the capability of ASCII text product retrieval by entering of the AI (CCCCNNNxxx) at the AWIPS workstation. The entry of the CCCC portion of the AI for retrieval purposes should be optional where the NNNxxx (4-6 characters) is unique. The capability of retrieval of text products by entry of the AI should be in addition to the capability of retrieval of the product by "pointing and shooting" on the user interface menus and sub-menus.

For ASCII text products received from the NWSTG without the NNNxxx portion of the AI as the first line of text, AWIPS should assign an appropriate NNNxxx based upon the WMO abbreviated heading and the decoding of the text. For example, a military upper air bulletin received under a WMO abbreviated heading of USUS11 KAWN and whose text began with TTAA 58121 72221 ... would be assigned the AI of KAWNMANVPS (the MAN derived from the TTAA indicating Part A (mandatory levels) of an upper air report and the block/station number of 72221 indicating Eglin AFB in Florida with a site identifier of VPS).

The display of text products on the AWIPS workstations should provide the WMO abbreviated heading as the first line, with the NNNxxx appearing on the line immediately below. These two lines of information provide all the elements of the AI (CCCCNNNxxx) and provide the unique identification of each ASCII text product on AWIPS. Multiple versions (or parts) of the same product should be differentiated by the date/time group and/or the BBB portion of the WMO abbreviated heading.

10.0 PRODUCT FORMATS

This section defines the structure (or format) of the products which will be transferred between the NOAA central facilities and the Contractor. The format of a product is dependent on the product's type and, in some cases, its source or use. There are five basic types into which all AWIPS products can be fit. These five types are defined below. The product format(s) will be defined under the appropriate type.

The product format specifications are defined for each product type and the appropriate detailed specification document(s) reference is provided in Sections 10.1 - 10.4. The most current version of the specifications and related documents are available in the AWIPS Program Library.

Any additions to, or clarifications of, a referenced document, necessary for AWIPS are included below.

10.1 GRAPHIC

A graphic is any representation of data derived from other sources that is displayed in vector form.

The format for graphics products transmitted between the NOAA centralized computing facilities and the Contractor is that found in the Federal Coordinator for Meteorological Services and Supporting Research Standard Format for Weather Data Exchange Among Automated Weather Information Systems (FCM-S2-1990, "the Red Book") May 1990. The May 1990 version contains modifications to support AWIPS.

10.2 GRID

A grid is a mathematically definable array, usually two-dimensional, of points, each of which is assigned a geographical location and a corresponding value from a data field.

The grid format to be used is defined in the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, National Meteorological Center, GRIB, (WMO Code FM 92-VIII Ext.), The WMO Format For The Storage of Weather Product Information And The Exchange of Weather Product Messages in Gridded Binary Form.

10.3 POINT DATA

Point data is any observation or forecast of a meteorological, hydrological, oceanographic, or geophysical variable on, above, or below the earth's surface, made by a person, processor, or sensor. They will be provided in several formats. Refer System Segment Specification (SSS), Appendix K, Tables K.2.6 and K.5.1-K.5.3 in the Notes for more specifics.

Several point data will be transmitted in BUFR format from the NWSTG. In some cases the data originate from another source in BUFR while a few will be converted to BUFR by the NWSTG prior to providing them to the contractor. Other point data for which conversion to BUFR is not practical will be provided in ASCII character (text) form. Reference the ANSI X3.4-1986 - Coded

Character Set - 7 Bit American National Standards Code For Information Exchange.

10.3.1 BUFR

The WMO FM 94 BUFR-IX - Binary Universal Form for Data Representation, February, 1988, specifies the format for point data provided in BUFR format.

10.4 FREE TEXT

Free text includes any product written in plain text or observation and for which encoding in BUFR is not practical.

All free-form text will be transmitted in ASCII character form. Reference the ANSI X3.4-1986 - Coded Character Set - 7 Bit American National Standards Code For Information Exchange.

11.0 AWIPS MULTIPOINT-TO-POINT (AMP) PRODUCT FORMATS

The Contractor should transfer the products originating from the AWIPS Communications Network to the NWSTG (the AWIPS Multipoint-to-Point Data) in the standard product formats defined in previous subsections; 10.1 GRAPHIC, Red Book format for graphics, 10.2 GRIB, format for gridded data, and 10.4 FREE TEXT, ASCII character form for free-form text and observations. There currently are no requirements for AMP products to be originated in BUFR format.

The AMP data should be identified by the appropriate WMO abbreviated heading, employing the same product identification scheme for products provided to the Contractor from the NWSTG interface defined in subsection 9.2, AWIPS Product Identification.

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